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Exchanging implements: the micro-materialities of multidisciplinary work in the operating theatre

Christian Heath and Paul Luff

Abstract

Surgical procedures rely upon an array of commonplace tools, implements and materials that mediate practice and disciplinary collaboration within the operating theatre. Substantial time is dedicated to the issue and provision of these artefacts and their timely exchange is critical to the successful accomplishment of surgical procedures. In this paper, we consider the practice, knowledge and agency that enables particular implements and materials to be handled and passed from one to the other that in turn enables their deployment with regard to the particular procedure and the contingencies 'at hand'. We address the technicalities of these 'non-technical skills' and examine how they rely upon a disciplinary vision and interactional organisation that informs both the scrutiny of action and the ways in which implements and materials are exchanged with the surgeon.

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Introduction

In recent years we have witnessed a number of remarkable developments in surgical procedures and the technologies that are used to undertake operations. Notwithstanding these developments, many, if not most procedures, rely upon commonplace objects and artefacts - hammers, chisels, pliers, drills, scissors, tweezers and the like – albeit in a modified form. These implements and materials not only enable the performance of highly complex procedures but embody complex divisions of labour, knowledge and expertise that underpin their availability, deployment and use. As Moreira (2004) suggests, drawing on Callon and Rabearisoa (1999), surgery offers the opportunity to consider the ways in which particular ‘mediations’ are associated with (re)configuring patient’s bodies – ‘unfolding compositions of bodies, competences, artefacts and procedures and emotions’ (2004:35). It also provides a work site, a ‘centre of coordination’ (2004:36, Suchman 1996) with which to explore how objects and artefacts mediate, and reflexively constitute, interrelations between personnel and to consider the differential forms of practice, knowledge and agency that enable the situated accomplishment of complex procedures.

There is a growing interest in re-conceptualising health and illness in terms of practice, treating practice as the ‘primary unit of enquiry’ (see for example Moll 2002, Moll and Law 2004, and more recently Carmel 2013, Cohn 2014, and Twine 2015). Notwithstanding the important, but very different contributions of Giddens and Bourdieu to our understanding of practice, these initiatives have been largely informed by the contributions of Latour (1987, 2000) and others within science and technology studies, and the commitment to taking the nonhuman, the material, and its agency seriously; to consider the interdependencies and interconnectedness of the human and nonhuman in action (see for example Maller 2015). Despite the very different theories of practice found within contemporary social science, practice and its performance increasingly encompasses the material - objects, bodies,

artefacts, tools, technologies (see for instance Schatzki 2001, 2002, Shove et al. 2012). Reckwitz (2002), for example, defines practice as ‘routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, ‘things’ and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge’ (2002: 249-50).

These developments and their commitment to drawing attention to the importance of materiality in social action are to be welcomed. It is not surprising however to find that the emphasis on interdependency and interconnectedness has given analytic priority to the idea of networks, variously conceptualized, as the vehicle through which practice is instantiated and institutionalised. The performance of practice has received less attention and yet there is a longstanding recognition that how practices emerge and how they change over time is of critical importance (see for example Moll 2002, Maller 2015). In turn these questions raise issues concerning how particular practices are applied on actual occasions with regard to the particular circumstances at hand, ‘the isolated moments in the performance of a practice’ (Maller 2015:59). It is sometimes suggested that the deployment of a particular practice may simply constitute the ‘tip of the iceberg’ and yet, the occasioned performance of a practice raises important questions concerning agency and competence, the tacit knowledge, know-how and practical reasoning that enables and forms a critical aspect of particular practices.

Surgical procedures are interesting in this regard. Within the operating theatre substantial time and resources are dedicated to providing surgeons with timely and efficient access to surgical equipment. In the UK as elsewhere, it is the scrub nurse or theatre assistant, who is principally responsible for providing the surgeon with the various implements and materials required during the operation; a role that was first proposed by Gilbreth (see for example Gilbreth 1908, George 1968) in light of his research on surgery and work in the operating theatre. It is widely recognized that even small delays in the provision of an implement can threaten the performance of the procedure and lead to tensions within the surgical team. A brief review of on-line nursing forums and our own discussions with the members of surgical

teams suggest that knowing which implements are required, when, and how is the most challenging aspect of becoming a scrub nurse. These challenges can be exacerbated by variations in equipment and the ways in which particular surgeons perform certain procedures, the demands of working in transient teams, and in some cases, integrating moments of surgical training and a host of other demands into the concerted accomplishment of the surgical procedure (see for example Gillespie et al 2013, Mardell 1998, Silén-Lipponen et al. 2005, Bezemer et al. 2011a, 2011b, in press). Timmons and Tanner (2004, 2005) suggest that a crucial feature of the role of surgical assistant is to 'keep the surgeon happy' and to adopt what they characterise as the 'hostess role' - a form of emotional labour that relies upon, to use Lave and Wenger's (1991) term, 'legitimate peripheral participation'. These issues resonate with research by Finn and Waring (2006) and Finn and Mitchell (2009) who draw particular attention to the 'non-technical skills' required by the scrub or theatre nurse and the importance of 'situated awareness', 'mind-reading' and 'mood reading' to the performance of the role and the ability provide surgeons with the relevant tools and materials in an appropriate and timely fashion. They also underscore the arguments of Di Palma (2004) and Goodwin (2007) that successful teamwork derives not from strict adherence to prescribed roles but in the transformation and adjustment of practice where disruptions 'are a necessary part of the development of expertise' (Goodwin 2007:273); an argument that echoes issues raised by Hughes (1958) and his students in their pioneering ethnographies of work and occupations.

As Pilnick et al. (2009) point out; we have witnessed the development of a growing corpus of studies of interaction in health care in recent years, which consider settings beyond the doctor-patient consultation. Anaesthesia and surgery have proved of particular interest in this regard and served to draw analytic attention to the complexities of team work within health care and the forms of communication and interaction that enable the collaborative production of complex surgical procedures (e.g. Bezemer et al. 2011a, 2011b, Koschmann 2012, Koschmann et al. 2007, Mondada 2014, Hindmarsh & Pilnick 2002, Pilnick &

Hindmarsh 1999). In this regard, there are a number of highly insightful studies that have examined the interaction that arises between assistants, nurses and surgeons, focusing in particular on instructions, directives and requests and the forms of talk that enable the exchange of implements (see for instance Mondada 2014, Koschmann 2012 and a series of papers by Bezemer and colleagues, for example Bezemer et al. 2011a, 2011b and Korkiakangas et al. 2014). The bodily actions through which implements and materials are grasped, manipulated and exchanged have received less attention and yet the interaction that arises in and through the bodily conduct of personnel within the operating theatre is critical to the successful accomplishment of the operation. More generally, notwithstanding the burgeoning interest in body work and material practice in health care (including Carmel 2013, Cohn 2014, McDowell 2009, Twigg, 2011 and Twine 2015), the ways in which bodily conduct as embodied interaction features in the collaborative production of medical work remains relatively unexplored.

In this paper, we wish to consider the simple exchange of implements during surgical procedures, and explore the practice, knowledge, and competences that enable surgical assistants to pass objects and artefacts to the surgeon in a relevant and timely manner. Little talk or explicit communications arises to enable these exchanges; they rely upon complex and contingent forms of bodily action and interaction. We explore the forms of practice and agency that enable these mundane exchanges and consider the interdependencies that mediate the differential forms of labour, knowledge and expertise on which surgical procedures and teamwork rely.

The data on which the paper is based consists of a corpus of videorecordings augmented by field studies, gathered over a number of years in two hospitals – a teaching hospital in central London and a general hospital in a rural English city. We primarily gathered data on two types of surgery, neurosurgery, concerned with removing tumours, and orthopaedics,

mainly hip, and knee operations¹. Alongside data collection, we also held meetings, data analysis workshops with some members of the surgical teams in which we examined and discussed sections of the recorded data. These meetings proved invaluable, allowing us to clarify certain aspects of the procedure and practice, and to recognise particular contingencies and concerns that arose during the operation. Analysis drew on ethnomethodology and conversation analysis and in particular focused on the sequential, procedural and emergent character of the participants' action; it involved extensive transcription in which we transcribed both the visible and vocal, the multimodal, features of sections of the recorded data (Heath et al. 2010). The description and presentation of bodily action and interaction within text poses significant challenges. Unlike other forms of qualitative study, transcripts or extracts from field notes provide little sense of the character and complexities of the action. In this article, we use still frames taken from the original videorecordings to illuminate the aspects of the bodily action and interaction that enables the handling and exchange of implements.

We wish to begin by considering how the emergent and contingent structure of the procedure occasions, and renders relevant, the arrangement and timely provision of implements and materials.

Trajectories of exchange

Even relatively simple surgical procedures require a range of tools and materials that are deployed during successive stages during the operation. For example, a routine orthopaedic operation such as a hip replacement or knee surgery will involve well in excess of thirty different implements, some of which will be repeatedly deployed during particular stages of the operation. This number excludes materials such as swabs and the like that are a necessary feature of performing the operation. Although a number of these implements have distinctive

¹ The materials were collected following ethical clearance from the Health Trusts and the hospitals involved in the study. These adhered to guidelines provided by the UK's Economic and Social Science Research Council (ESRC). The agreement was that images of patients could be used only if patients could not be identified from any images or texts that were published by the researchers.

characteristics, many have a familiar, commonplace appearance, tools such as hammers, pliers, scissors and drills (See Figure 1a).

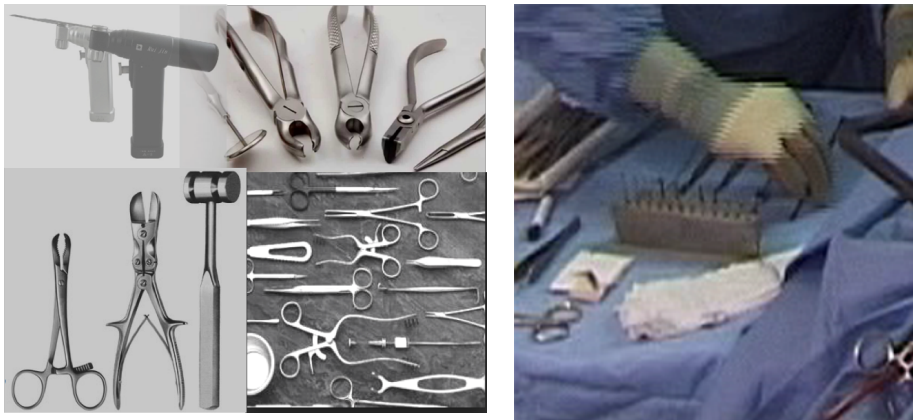


Figure 1: A range of implements used in orthopaedic surgery (left) A scrub nurse arranging a set of implements on a Mayo Stand so they are ready for use during the upcoming phase of the operation.

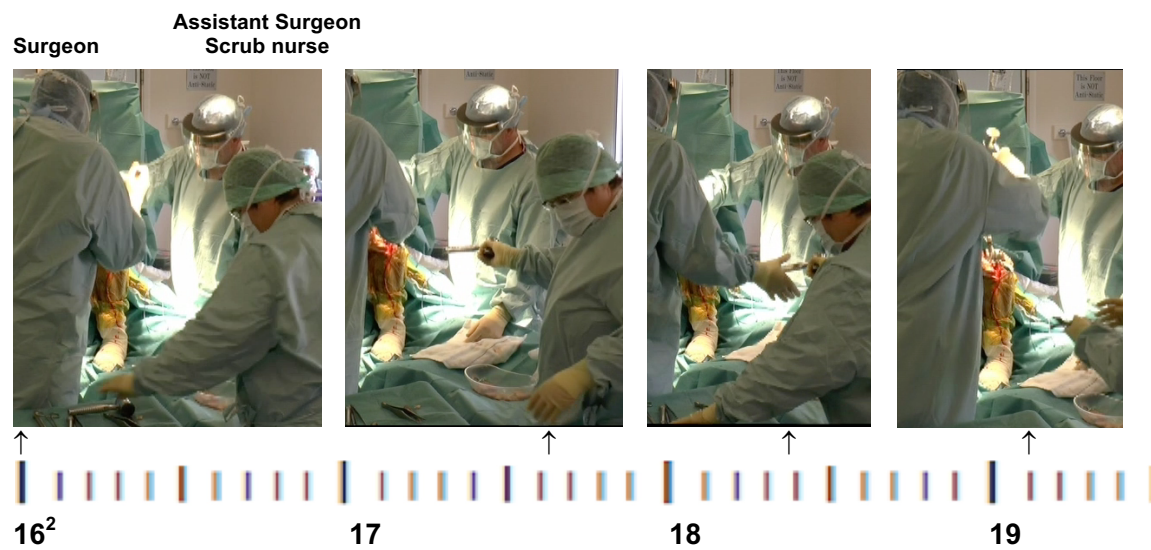
Before the operation the scrub nurse prepares the supplies and equipment required for the procedure. The sets of tools and implements are typically placed and arranged on tables close to the operating bed; the Mayo Stand that is used to hold implements that are more frequently used during any current stage of the operation (see Figure 1b) and the Instrument or Back Table that provides a surface for all implements and sterile supplies.

The position of the Mayo Stand and Instrument Tables is critical to the ability of the scrub nurse to view and to remain sensitive to the contingent performance of the procedure (Korkiakangas et al. 2014). In preparing the Mayo Stand in advance of the procedure's start, the scrub nurse, selects and arranges implements to enable those that are used frequently and those used at the beginning of the operation are positioned towards the front and centre of the table. These are selected and placed depending on the specific characteristics of the case at hand, the anticipated temporal organization of the procedure and the preferences of the particular surgeon. As the procedure develops, implements are used and returned, the spatial distribution of the various objects and artefacts on the Mayo Stand is ongoingly reconfigured to enable unfettered and easy access to particular implements and materials – whereas others of less immediate relevance are (re)positioned on the perimeter or moved to the Instrument

table. There is a *dynamic micro-ecology* to the arrangement and distribution of equipment that enables particular objects and families of objects to be found and grasped with ease.

During the operation surgeons do not typically have to wait for or summon a particular implement. The scrub nurse anticipates, precisely, just what is required and when enabling the surgeon to turn, grasp and deploy the implement in a timely fashion. The following example is drawn from an operation on a patient's knee and the surgeon is preparing the patella to receive a trial implant. This involves securing a jig at the top of the tibia with four pins that are inserted using a surgical hammer. Within less than twenty seconds, the scrub nurse passes a series of implements and materials to the surgeon, including pliers, pins, a clamp, a broach, and a surgical hammer, a number of which are also returned. No talk is exchanged during this part of the operation. The surgeon issues no request for any of the implements, be it verbal or nonverbal. It is worthwhile considering one of these exchanges (Fragment 1). As the surgeon positions a pin in the jig with the pliers, the scrub nurse takes the hammer from the Mayo Stand with her left hand (16), she then transfers it to her right hand and towards the surgical field, to the right of the surgeon (17). After he has positioned the pin, he extends his right arm to take the hammer (18). He immediately lifts the hammer to strike the pin (19). Before the hammer is taken the scrub nurse turns towards the Mayo Stand and selects the next implement (a clamp) with her left hand. As the surgeon starts to hammer, the nurse is ready to pass the clamp.

Fragment 1



The ways in which the scrub nurse issues the implements and materials enables the surgeon to perform the procedure with regard to the emergent technical requirements of the task rather than interweave, intersperse or delay its production with regard to securing the correct equipment. By anticipating just what is required and when, the scrub nurse is able to preserve the integrity of the procedure, enabling each successive action to be performed, without the necessity to seek, or to wait for, particular implements.

The practice that enables timely selection and exchange of implements and materials relies upon an interactional and sequential organization. The production of successive actions by the surgeon within the developing course of a procedure, renders relevant, particular actions by the scrub nurse; actions that implicate the selection and exchange of particular implements or materials. Within the overall procedure, particular tasks rely upon packages and orders of serial action that require assemblies of particular implements and materials that in turn render relevant, implicate, particular actions by the scrub nurse, actions that involve ways of arranging, handling and exchanging, particular objects and artefacts. The routine trajectory and emerging performance of the procedure serves to project the relevance of

² As there is often little, if any, talk in the presented fragments, images are provided and related to the timing of particular activities. Times are given in terms of seconds from the beginning of the fragment. In this case, for example, the activities in question commence 16 seconds into the fragment and last just over 3 seconds. The arrows indicate when the action recorded in the image occurred.

particular actions and their implements and materials that in turn create an obligation for their timely provision and exchange. The performance of the procedure relies upon the interdependencies of task structure and interactional organization, its routine operation provides the scrub nurse with ways of seeing, discriminating and making sense of the emerging activity in order to reliably recognize and anticipate just what implement or material is, or may be, required, in what way and when. Terms such as ‘situational awareness’ and ‘mindreading’ (see for example Finn and Mitchel 2009, Korkiakangos et al 2014) are interesting in this regard, but draw analytic attention away from the interdependence of procedural knowledge and interactional organization, the practice, that enables the systematic scrutiny of the procedure’s accomplishment and the contingent issue and exchange of implements and materials.

The interactional and sequential relevancies that serve to occasion and engender the issue of an implement during the procedure’s accomplishment are one aspect of the practice through which they are exchanged in an appropriate and professional manner. An efficient exchange however is dependent, not just on the timeliness and relevance of the implement or material, but on the ways in which particular objects and artefacts are held, handled and handed. Indeed, the very ways in which implements and materials are passed to the surgeon are sensitive to the specifics of their application; just as the specifics of the application engender sequentially relevant actions and activities from the scrub nurse.

The design of an exchange

There has been a long-standing debate in the social sciences concerning the qualities and affordances of particular objects and artefacts and the ways in which these characteristics inform how particular objects are perceived, handled and used (Norman 1988). One aspect of the qualities and affordances of implements and materials are the conventions associated with the ways in which they are passed from one to another. From an early age we are taught how particular objects and artefacts, such as knives, scissors, hammers and the like, should be

passed, conventions that one suspects are in part designed to avoid the risk of injury. These conventions are reflected in part in how certain implements and materials are exchanged within the operating theatre, between scrub nurse and surgeon. There is however significant variation in the ways in which the same object and artefact is passed to the surgeon even during the same procedure. In other words, the performance of the practice is highly variable and the differences in the way in which an implement or material is exchanged and the contingencies that bear upon its performance may be of some importance to the interprofessional and accountable production of the procedure. Consider the following examples.

Fragment 2



Passing the dilator

Fragment 3



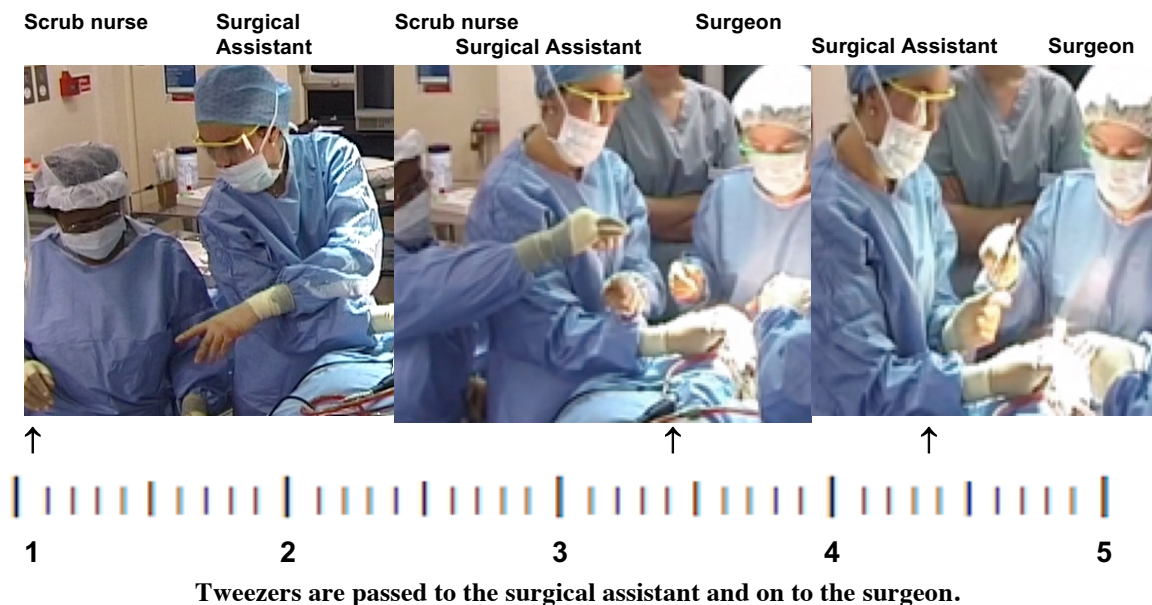
Passing the swab

In Fragment 2, the scrub nurse clasps the dilator (a long tube) at both ends and passes it horizontally to the surgeon. The surgeon is able to grasp the dilator with his thumb and forefinger in the centre of the rod. Without adjusting or repositioning his hand, he immediately inserts the head of the dilator into the patient's oesophagus. Swabs are passed in a variety of ways during a procedure – tightly folded, scrunched, fully open, and the like. In Fragment 3, as the scrub nurse transports the swab from the Mayo Stand to the surgeon she shakes it open. The surgeon grasps the swab and, making no adjustment to how it is held or formed, she immediately applies it to the wound.

In both cases, how the instrument or material is passed to the surgeon is *prospectively* oriented to the specifics of the particular action that will be undertaken on this occasion. The way in which particular object is passed, enables the surgeon to grasp and apply the instrument or material without the necessity to adjust or reposition the way in which it is received and held. The character of these exchanges suggests an extraordinary economy of action that relies on the ability of the scrub nurse to prospectively envisage just how the instrument or material will be deployed on this occasion and pass the object to enable the relevant grasping that in turn eases its application. Just how the scrub nurse clasps, handles and transports the instrument or material, reveals a remarkable sensitivity, not just to the specific characteristics of the action that will be undertaken by the surgeon, but to the way in which the object will need to be grasped by its recipient to enable its immediate deployment.

Even where a member of the surgical team may request, either vocally or visibly, an implement on behalf of a colleague to undertake a particular procedure, the scrub nurse will structure the exchange with regard to its eventual application. In the following case, the surgical assistant requests tweezers, using a pincer gesture (1). The scrub nurse passes the tweezers to the surgical assistant (3) that in turn he passes immediately on to the surgeon (4).

Fragment 4



As she takes the tweezers from the Mayo Stand, the scrub nurse repositions the tweezers in her hand so she grips the head rather than the pincers. The assistant grasps the base of the pincers and in turn passes the tweezers to the surgeon. The surgeon is able grasp the head and immediately uses the tweezers to remove gauze from the patient's wound. The handling and exchange of the tweezers by the scrub nurse is oriented to and shaped with regard to the action after next, enabling the surgeon to use the implement. Although mediated by the actions of the assistant, the surgeon is passed the object and does not need to adjust her hand or fingers, to undertake the specific task at hand. In other words, the specific ways in which a particular implement or material is grasped, handled and transported, its materiality, is constituted with regard to the anticipated characteristics of the action to be performed by the surgeon. The object's differential handling by members of the surgical team is configured in and through their interaction and designed to enable its immediate application.

The complexities and considerations that inform how the scrub nurse passes implements and materials to the surgeon stands in marked contrast to how they are returned. Indeed, it is not unusual to find the surgeon, not passing, but simply putting an implement on the Mayo Stand with little regard to its proper positioning or prospective use. Even when implements

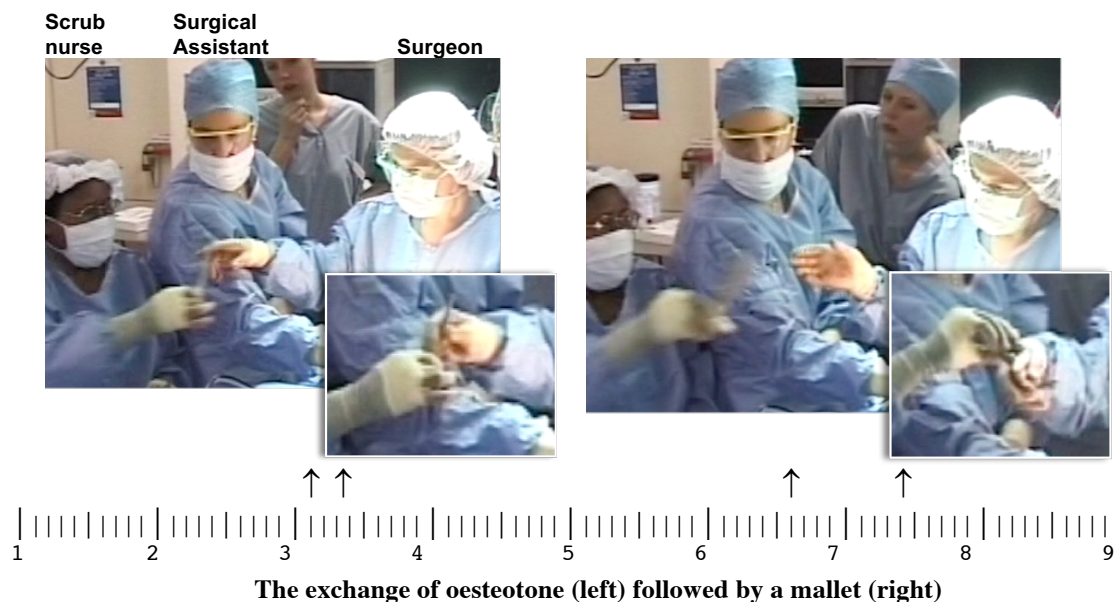
are returned directly to the scrub nurse, they display little recognition of when or how they will be received or taken in hand. The contrasting forms of exchange not only serve to powerfully expose the social divisions and divisions of labour within the operating theatre, but also the participants' orientation to the surgical procedure as the principal activity at hand. The structure of action, even in its finest detail, is organized with regard to the accountable, routine performance of the principal task and the contingent demands that necessarily shape its proper accomplishment.

The instructing hand and the calibration of exchange

In passing implements and materials to the surgeon, the scrub nurse relies upon a body of tacit knowledge and understanding concerning the practicalities of particular procedures and how particular implements and materials will be deployed. This knowledge and understanding is very different from that of the surgeon. Unlike say apprentices that serve as assistants in other occupations, such as bricklaying or plumbing, it would not necessarily allow the scrub nurse to perform the procedure, and yet it provides the resources to scrutinize the procedure's accomplishment to issue the right object in the correct form with regard to how it will be deployed. Within the framework of relevance and responsibility that enables the scrub nurse to know and anticipate which instrument or material will be required to perform particular tasks during the procedure, we find a systematic and prospective orientation to the characteristics of particular tasks that are to be undertaken on this occasion and that inform just how the object or artefact should be passed on this occasion. Anticipating how an instrument or material should be passed, however, does not enable the scrub nurse to know just how it will be passed on this occasion; an actual exchange relies upon an emergent process of collaborative action through which the participants calibrate the transport, exchange and withdrawal of the object or artefact in the course of it passing from one hand and one body to the other.

Consider the following exchanges that follow one from the other in quick succession; the scrub nurse passes the surgeon a small oosteotome or chisel (3) followed by a mallet (6) with which the surgeon chips away at the bone that surrounds the eye cavity.

Fragment 5



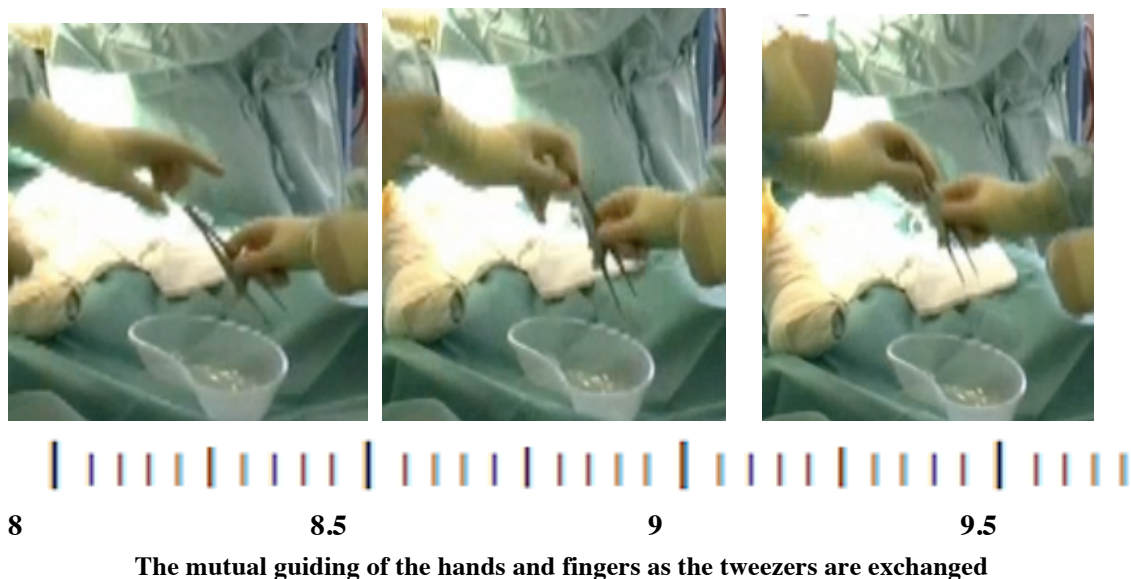
As the scrub nurse lifts the oosteotome from the Mayo Stand, the surgeon reaches for the implement. The surgeon orients her reaching hand vertically, with the thumb and forefinger forming a sideways ‘U’. As the oosteotome is transported towards the hand, the scrub nurse transforms how it is held, raising it vertically and placing it within the ‘U’. The surgeon’s thumb and forefinger enfold the oosteotome. It is immediately withdrawn by the surgeon. In contrast, as the scrub nurse lifts the mallet from the Mayo Stand, the surgeon’s reaching hand is aligned vertically, with the palm of the hand open and the thumb to one side. As the mallet nears the hand, the scrub nurse turns and raises the handle and positions it within the open hand. It is grasped by the surgeon and immediately deployed. Without little adjustment, the surgeon strikes the oosteotome.

In both cases, the emerging shape, orientation and position of the surgeon’s hand and fingers provides the scrub nurse with the resources with which to determine just how the implement should be passed on this occasion. The reaching hand of the surgeon provides, for

want of a better term, an *embodied instruction*, enabling the scrub nurse to configure how the object is held in the course of its transportation to enable it to be grasped in a particular way by the surgeon. So, while the scrub nurse anticipates the relevance of the particular tool and implement and can determine how it is likely to be applied in these circumstances, the very ways in which the surgeon reaches to receive the implement provides resources with which to determine just how it should be passed at this moment. These micro-interactions, reveal a remarkable deference to the surgeon and the principal task at hand, in which the very moment of exchange is determined, in part, by the emerging shape of the surgeon's hand as it reaches for the implement in question.

The exchange of implements and materials between a scrub nurse and surgeon rarely involve simply holding or placing an object and having the other remove it from one's hand or a nearby surface. Passing, from one person's hand to another, is a process that necessitates an evolving complex of coordinated action and interaction. It is worthwhile, briefly considering the following fragment, as the scrub nurse passes a pair of tweezers to the surgeon.

Fragment 6



As the scrub nurse removes the tweezers from the container, the surgeon reaches towards the implement (8), the thumb and forefinger, once again forming a 'U' shape. As the

hand nears, the scrub nurse realigns the tweezers and inserts the head between the forefinger and thumb. The surgeon encloses the head of the tweezers around his thumb and fingers (9). The scrub nurse does not release the tweezers. Rather, as the surgeon clasps and begins to withdraw the implement, the scrub nurse continues to hold the implement, her moving hand following its transportation upwards, and back, towards the surgical field (9.5). As the surgeon withdraws the tweezers, their trajectory appears to be slightly realigned and momentarily the scrub nurse releases her grip and removes her hand.

The exchange relies upon an emergent process of action and interaction in which the implement is positioned to enable the other's thumb and finger(s) to clasp the object and then, simultaneously, the two hands, clasping distinct elements of the same object, move in unison, until one releases the object. Letting go of the object, its release, is dependent upon its giver, the scrub nurses having a *sense of security* that the object is now secure within the other's hand, a sense of security that arises by virtue of following and feeling (through the material object) the implement's removal. The exchange of the implement relies upon the ability of the scrub nurse to anticipate the trajectory and pace of the object's withdrawal, to enable the giving hand to follow with the movement of the other and avoid any disruption to the pace or path to its removal. The exchange of the object, even in the course of its transfer from one to the other, relies on a remarkable sensitivity and orientation to the concurrent action(s) of the co-participant and the contingent trajectory of removal they project within the course of their articulation.

Problems and difficulties do inevitably emerge in the exchange of implements during an operation even amongst teams who have a longstanding working relationship. There may for example, be constraints on the visibility of the operational field during the procedure and this may undermine the ability to identify just what is needed and when and notwithstanding lengthy instruction concerning the use of new tools and implements, confusion can still remain concerning the appropriate tool required for a specific task. Within the exchange itself we occasionally find that objects are dropped as they are passed or for example the scrub

nurse will have to abandon passing one implement and quickly substitute an alternative in consequence of a momentary change in the procedure. It is not unusual to find that slips and difficulties arise by virtue of the ways in which the surgeon's hand is momentarily formed as the implement or material is about to be exchanged. The scrub nurse orients to the emerging shape of the surgeon's hand only to find, as the implement is about to be passed, that the recipient's adopts a very different shape and even position in which to receive the object. It is not unusual for these difficulties to arise by virtue of the surgeon's primary commitment to surgical field and the contingent demands of the procedure so that, in reaching for implements or materials, the surgeon, disregards, or is momentarily insensitive to the ways in which an object is being passed by the scrub nurse even though the implement is oriented to the reaching hand. It is perhaps ironic that the remarkable micro-competencies of the scrub nurse that serve to engender a confidence in an object's transfer creates a dependency that can occasionally threaten the smooth transfer of implements and materials.

Discussion: agency, practice and embodied action

The timely and relevant provision of implements and materials by the scrub nurse relies upon a body of knowledge, skill and understanding that stands in marked contrast to the that of the surgeon. The scrub nurse is neither expected nor able to perform the procedure, but the procedure relies upon the scrub nurse's abilities to assess and discriminate its ongoing production and to recognize just when and how particular implements and materials are required. Indeed, the very ways in which a surgeon's hand reaches for and is shaped with regard to an object's reception, is critical to how the object is, and how it should be, exchanged. These micro-competencies and skills mediate the relation between scrub nurse and surgeon and constitute, mutually, the qualities and characteristic of the objects, their occasioned materiality and momentary sense in their passing. How the scrub nurse arranges, grasps, handles, manipulates and passes implements within the operating theatre is a highly specialized activity, an activity that is dependent upon an extraordinary sensitivity to the

contingent production of medical procedures and the occasioned requirements of each and every exchange. It relies on and reproduces, *par excellence*, the interdependence of technical and craft knowledge (Carmel 2013, Pope 2002), critical to collaborative accomplishment of surgical procedures.

How these material objects and artefacts are configured and constituted in their exchange arises in and through the interaction between scrub nurse and surgeon. Indeed, the surgeon's ability to conduct the procedure is dependent upon, and presupposes, the ability of the scrub nurse to discriminate and assess the interactional and material relevancies of the task through an ongoing 'analysis' of the conduct of the surgeon. The issue and exchange of implements relies upon interdependent and concurrent elements of interactional organisation that are embedded and entailed within particular activities that include, amongst other considerations, - the routine structure of the procedure, characteristics of the artefact, the specifics of the application, the reaching hand of the surgeon, and the process of transfer. These elements are dependent upon, and accomplished through, concurrent sequences, packages and trajectories of bodily action that contingently establish particular relevancies and in turn contribute to an emerging framework of activity that enables the collaborative manipulation and exchange of material artefacts. They provide ways of grasping, handling, and exchanging objects and the resources through which participants can prospectively assess and orientate to the conduct of the other, creating and adjusting action within the emerging course of the activity, and retrospectively, determine the sense and significance of the exchange on this occasion. Surgery relies upon a 'corporeality of interactions' (see McDowell 2009, and Twigg et al. 2011) that mediates differential occupational practice and identity. In the process of exchange, participants orient to and instantiate asymmetries of expertise and influence, and reproduce a remarkable deference to the emergent requirements of the task and the surgeon. Like other forms of medical practice, the production of particular procedures is dependent upon the systematic, collaborative production of complex tasks in and through bodily action

and interaction that reflexively reconstitutes the occasioned sense and significance of material objects and artefacts during the concerted accomplishment of particular activities.

Social practice theories, in their various forms, have been invaluable in drawing analytic attention to the interdependencies of human and nonhuman, the 'interconnectedness of elements', 'forms of bodily activities, forms of mental activities, 'things' and their use' (Reckwitz 2002:49-50). Notwithstanding the very different characterisations of practice, neatly summarized by Shove and Pantzar (2005) with the terms material, meaning and competence, it is interesting to note that the situated or occasioned performance of particular practices remains relatively underexplored. While specific performances may well constitute the 'tip of the iceberg', it is through detailed analysis of specific instances, the circumstances of their use, that we can begin to discover the competencies, skills, the 'know how', that enables, and is, practice.

The exchange of instruments and materials during a surgical procedure is interesting in this regard. It provides an opportunity to explore the contingencies and considerations that inform their skilled use and how practice is embedded within the real time, contingent contributions of the co-participants. We can begin to see, how in this case, as in others, the interactional and the sequential is an inextricable aspect of practice. Indeed the practice consists, at least in part, of the knowledge, consideration and reasoning that enables the systematic orientation to, and coordination with, the concurrent action and activity of the co-participant(s). The idea or concept of 'performance' may have certain limitations in this regard. It can imply, inadvertently, that practice or practices, stand in some sense independently of their application and lead inquiry to neglect the contingent circumstances, the 'tip of the iceberg', in which participants deploy and produce practice. Alternative concepts such as 'enactment' (see for instance Mol 2002:41) may not resolve this tension and preserve an analytic distinction between practices and their application, between objects and their production, between procedures and their deployment. In the case at hand, we can begin to see how the socio-interactional is an inextricable feature of practice and the ways in which

the concurrent participation of others is perhaps the primordial ‘contingency’ that bears upon production of practice in action.

The performance of practice draws attention towards a long-standing concern within contemporary theories of practice that is agency, and the ways in which we can prioritise, analytically, agency in action and materiality. Grasping, holding, manipulating and exchanging implements during surgical procedures, points to the complexity of seemingly mundane, material action and the ways in which it mediates, the interrelations of scrub nurse, surgeon, patient and others. In his pioneering philosophical treatise, Tallis (2003) explores aspects of the hand’s agency:

Herein lies the true genius of the hand: out of fractional finger movements comes an infinite variety of grips and their combinations. And from this variety in turn comes choice - not only what we do, but in how we do it ... With choice comes consciousness of acting: the arbitrariness of choice between two equally sensible ways of achieving the same goal awakens the sense of agency.

Tallis (2003:174)

But within these slight moments of exchange, we find an aspect of agency that remains disregarded by Tallis and others, that is, the ways in which articulation of the hand and the body in touching, grasping, manipulating and exchanging objects is oriented to and dependent upon the emerging bodily conduct and comportment of co-participants. In other words, by taking the ‘isolated moments of the performance’ (Maller 2015) seriously, we can drive analytic attention towards the reasoning, knowledge, know-how and competencies on which people rely in the collaborative co-production of material and bodily actions and the practices that enable their concerted accomplishment. Prioritising the collaborative and interactional in practice, provides the opportunity to examine the richness and complexity of human agency that informs the production of even seemingly simple bodily and material activities that enable the routine delivery of health care.

Prioritising the analysis of the situated production of practice and the agency that is entailed therein, poses methodological challenges. As Mol and Law (2004) suggest, it has long been recognised that ethnographic scrutiny is critical to ‘foregrounding practices’ (2004:58) and indeed the practice turn has generated a substantial corpus of highly distinctive, broadly defined, ethnographic studies. If we are willing to consider that at least some of the activities in which we engage, the practices that enable their accomplishment are inextricably embedded within interaction, then ethnographic ‘recounting’ and associated methods provide limited resources with which to examine the situated, production of practical action. In this regard, developments in digital media and recording technologies, augmented by field studies, may enhance our ability to scrutinise the particular activities and bodily, material and spoken material conduct that is critical to the organisation and delivery of health care. These developments however, do not resolve the analytic challenges that arise in prioritising the contingent and situated, and in addressing the complexities that arise within the collaborative production of passing moments of social action. Indeed, even if we consider a seemingly simple matter such as the routine exchange of medical implements and materials, we find interdependent orders of organisation and participation that bear upon, and feature in, the transfer of objects and artefacts from one hand to another. There is complexity within the mundane that powerfully exposes the extraordinary richness of human agency but in turn challenges our abilities to expose, identify and analyse the concerted production of bodily and material action in practice.

In her analysis of anaesthetic practice, Goodwin (2007) suggests that standardisation can undermine the ability of participants to learn and develop expertise and difficulties and disruptions can facilitate the development of skilful, situated team-work and collaboration. One of the more radical, recent initiatives, requiring standardisation *in extremis*, is the development of the automated scrub nurse that issues implements and materials in response to commands from the surgeon (see for example ‘Gestonurse’ Jacob et al. 2011, Wachs, et al. 2014); a development that is founded, in part, upon the idea that robots are not subject to the

performance variation and error sometimes ascribed to surgical assistants. These initiatives reflect the ambivalent standing of the scrub nurse and her or his knowledge and expertise, that skills and competencies of the scrub nurse are ‘non-technical’ with the role primarily consisting of reading the mind and responding where necessary to the demands of the surgeon. In this paper, we have sought to demonstrate that the ability of the scrub nurse to issue instruments and materials in a timely and efficient manner that rests upon a systematic understanding, an ongoing analysis, of the procedure, its contingent accomplishment and the nuanced conduct of the surgeon. As Goodwin (2007) suggests, problems and difficulties, what Hughes (1958) characterised at least in part, as ‘mistakes at work’, are critical, enabling the scrub nurse to develop the acumen, the expertise and know how to enable instruments and materials to be available and issued with regard to the demands and constraints at hand, the circumstances and contingencies that bear upon the accountable production of such a seemingly, mundane task as handling and exchanging objects. It is perhaps ironic that a field of technical research that is increasingly concerned with the development of so-called ‘autonomous agents’, demonstrates little regard for the complex forms of agency that arise within these seemingly isolated moments of inter-professional practice.

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